CHAPTER 15 – BRIDGE DECK DRAINAGE SYSTEMS

CHAPTER 15 - BRIDGE DECK DRAINAGE SYSTEMS

15.1 Design Criteria

Roadways and bridges shall be designed to minimize surface flow on bridge decks. Bridge deck drainage systems may be used to collect and remove surface runoff as soon as possible, with due consideration given to the structure itself, as well as other factors which limit the type and placement of drainage system used.

15.1.1 Roadway And Bridge Design Procedures

The project manager shall follow the following basic rules to eliminate and/or minimize bridge deck drainage problems:

- Superelevation transitions, flat grades and sag vertical curves shall be avoided wherever possible on bridges. The minimum desirable longitudinal grade for bridge deck drainage is 0.5%

- Gutter flow drainage from the upslope roadway shall be collected before it reaches the bridge deck

- Runoff from bridge decks shall be collected immediately after it flows onto the subsequent roadway section where larger grates and inlet structures can be used

- Adequate cross slope must be provided so that water runs quickly toward the drain. The desirable minimum cross slope for bridges with a normal crown is 2%. In areas of intense rainfall, a somewhat steeper cross slope may be necessary to facilitate drainage. In such areas, the cross slope may be increased to 2.5%. Where three or more lanes are provided in each direction, the maximum pavement cross slope may be increased to 3%.

15.1.2 Design Spread And Frequency

- Rational Method shall be used for computing runoff for roadway and bridge decks

- Design Storm shall be a 10-year frequency storm, except that a 100-year frequency storm shall be used for bridges located where the low point of a sag vertical curve occurs on the bridge or approach slab (see Chapter 6 of this manual)

- Gutter spread shall be limited to the shoulder area during the design storm

15.1.3 Bridge Deck Drainage Systems

1. The standard bridge deck drainage system used by the GDOT is the placement of 4 inch diameter deck drains through the bridge deck along the face of the barrier or sidewalk curb (see Section 15.4).

2. If factors, such as the location of the bridge beam, prevent the standard deck drains from being used, the alternate system is placing 3 inch high by 6 inch wide deck drains through the barrier (see Section 15.4).

3. The following guidelines are used in the placement of the above standard and alternate deck drain systems:

a. The deck drains shall be spaced at 10-foot intervals along both sides of the bridge for normal crowns, and along the low side of the bridge for decks with constant cross slopes and superelevation. The deck drains shall be omitted over riprapped bridge endrolls. The deck drain spacing shall begin at 5 ft from the centerline of the intermediate bents;

b. Special consideration shall be given to drain spacing on structures with reverse horizontal curves occurring on the bridge. Sufficient drain openings will be provided to minimize 'cross flow ' onto traffic lanes at superelevation transition areas; and

c. Deck drainage shall not be allowed to fall onto railroad beds, roadways and other sensitive features. As a general rule, deck drains shall not be used in these cases. In cases where the bridge is very long and deck drainage is needed, the option to place standard deck drains in spans that would not drain onto the sensitive feature shall be investigated.

4. In special cases, where deck drainage is required and the standard deck drain system is insufficient, vertical drains with steel grate inlets and PVC pipe to transport the water to a collector can be used. A typical vertical inlet deck drain system is shown in Section 15.4.

15.2 Design Data Required

- Preliminary proposed roadway plans
- Preliminary bridge layout
- FHWA Hydraulic Engineering Circular No. 21 (HEC-21), *Design of Bridge Deck Drainage,*[(1)] May 1993
- Catalog of suppliers on List 11 of the Qualified Products Manual, "Foundries Supplying Gray Iron Drainage Castings"

15.3 Design Methods And Procedures

1. The roadway designer shall consider drainage early in the design phase. By avoiding superelevation transition, flat grades, and sag vertical curves on bridges, inlets on bridges can usually be eliminated. Adequate cross slope shall be provided on the bridge section so that the water runs quickly toward the drain.

2. The roadway designer shall calculate the gutter flow drainage from the upslope roadway using the Rational Method as shown in Chapter 6, "Pavement Drainage."

3. The roadway designer shall place and size a drainage structure(s) to collect the gutter flow drainage from the upslope roadway before it reaches the bridge deck. See Chapter 6 of this manual.

4. The roadway designer shall determine if the standard bridge deck drain systems as described in Section 15.1.3 are adequate. **The designer shall take into account that bridges over railroads, roadways, and other sensitive features may not have any deck drains incorporated into the structure.**

5. The roadway designer shall place and size a drainage structure(s) to collect the runoff from the bridge deck immediately after it flows onto the subsequent roadway section (see Chapter 6 of this manual).

6. If the roadway designer determines that the standard deck drains are inadequate for the bridge, the methods in the FHWA Hydraulic Engineering Circular No. 21 (HEC-21), *Design of Bridge Deck Drainage,*[(1)] shall be used to size an adequate deck drain system. A catalog from an approved supplier can be used to select a bridge drain system that will be satisfactory both hydraulically and structurally. The roadway designer and bridge structural designer shall meet and decide which deck drain system is the best for the bridge on a case-by-case basis.

7. The special design deck drain systems in (6) shall be designed to transport the water to a collector utilizing PVC pipe.

15.4 Typical Deck Drain Details Used By GDOT

Figure 15.1 – 4 inch diameter deck drains along the barrier

Figure 15.2 – 4 inch diameter deck drains along the sidewalk curb

Figure 15.3 – 3 inch by 6 inch wide deck drains through the barrier

Figure 15.4 – a typical vertical inlet deck drain system

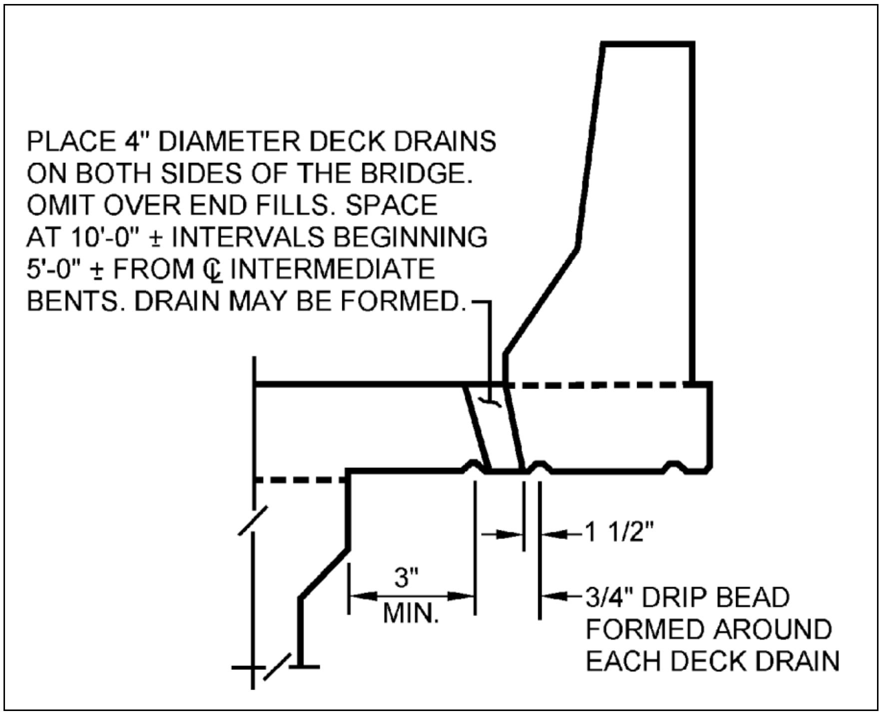

Figure 15.1. Four-inch diameter deck drain detail at barrier.

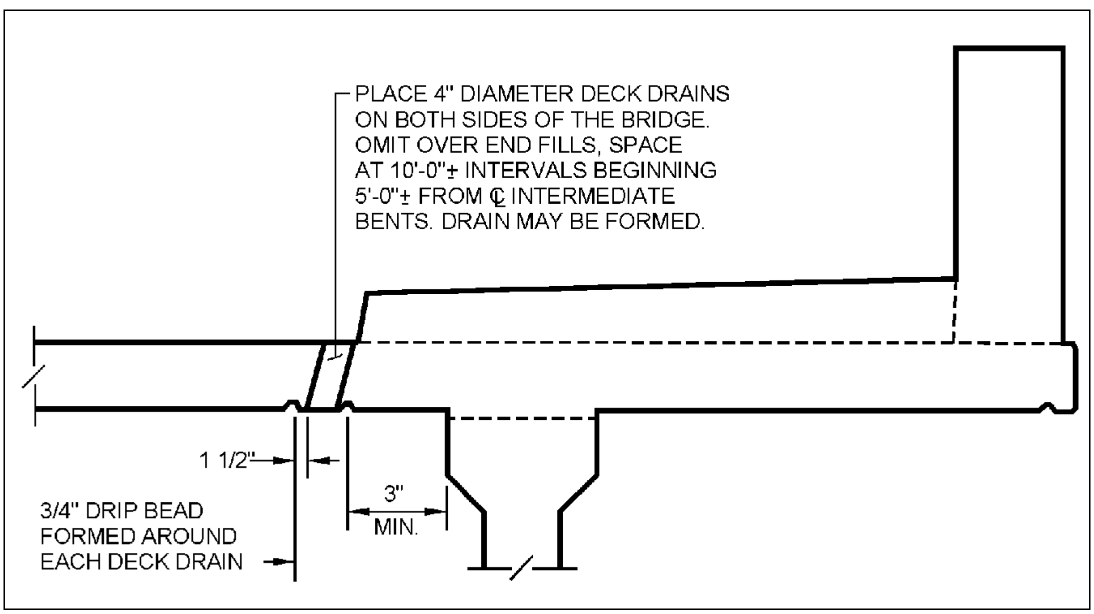

Figure 15.2. Four-inch deck drain detail at sidewalk.

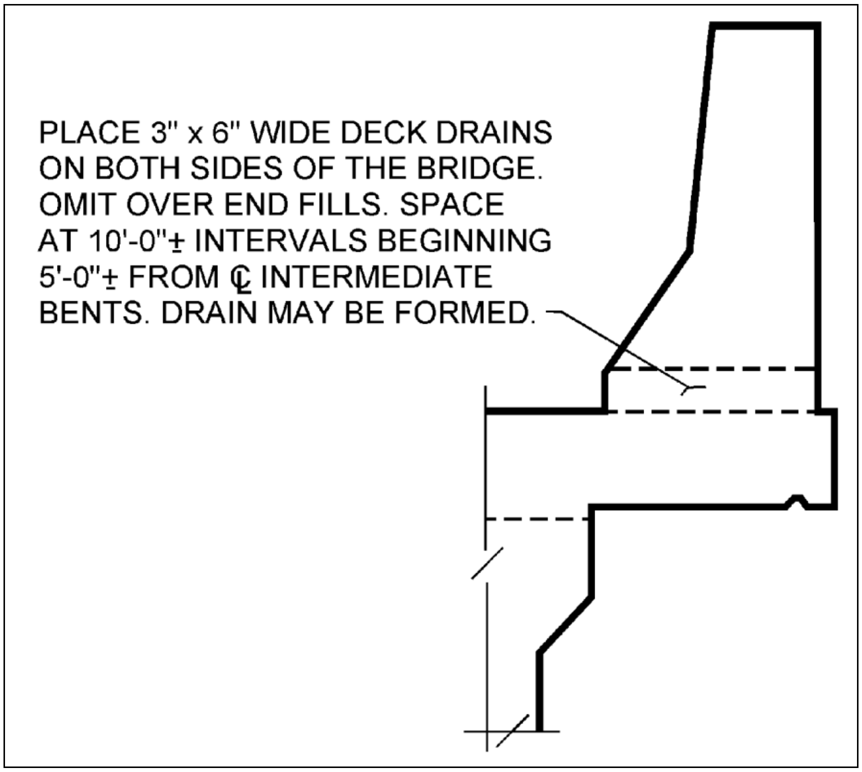

Figure 15.3. Three by six-inch deck drain detail through barrier.

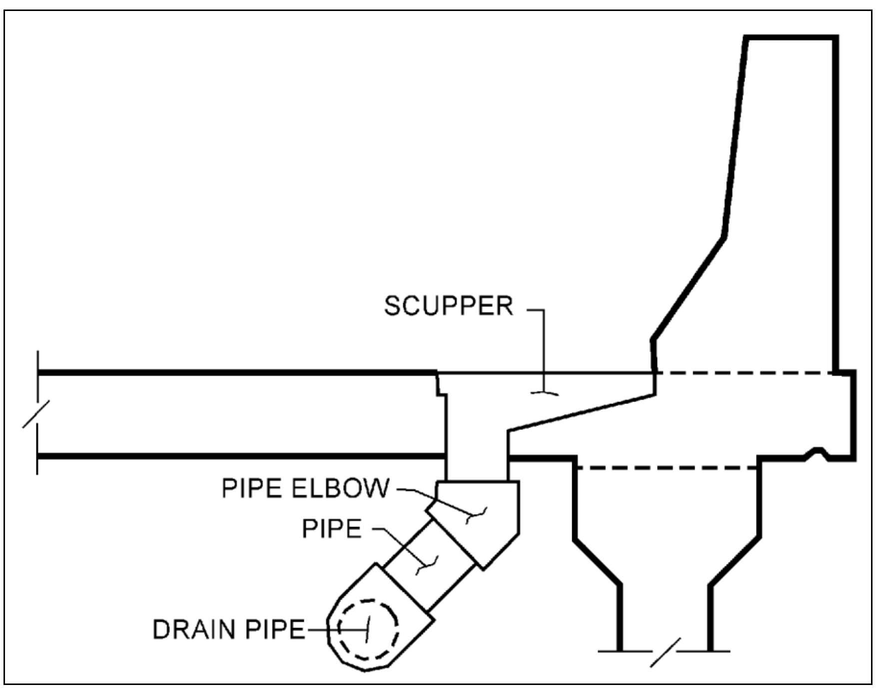

Figure 15.4. Deck drain system.

15.5 Analysis of Circular Scuppers

Equation 6.12 of Chapter 6 gives the following:

$Q_i = EQ$

where:

E	=	Efficiency
Q	=	Flow in the gutter for a given width of spread

The efficiency (E) of circular scuppers to be used with Equation 6.12 is given by Figure 15.5.

15.6 Design Examples

The roadway designer shall consult the FHWA Hydraulic Engineering Circular No. 21 (HEC-21), 'Design of Bridge Deck Drainage,' which contains comprehensive examples of bridge deck drain design or follow the procedures given in Chapter 6 of this manual for bridges on a grade.

References

1. Young, G.K., Walker, S.E., and Chang, F., 1993. *Design of Bridge Deck Drainage Systems, HEC-21, Publication Number FHWA-SA-92-010,* Federal Highway Administration, Washington, D.C., May.

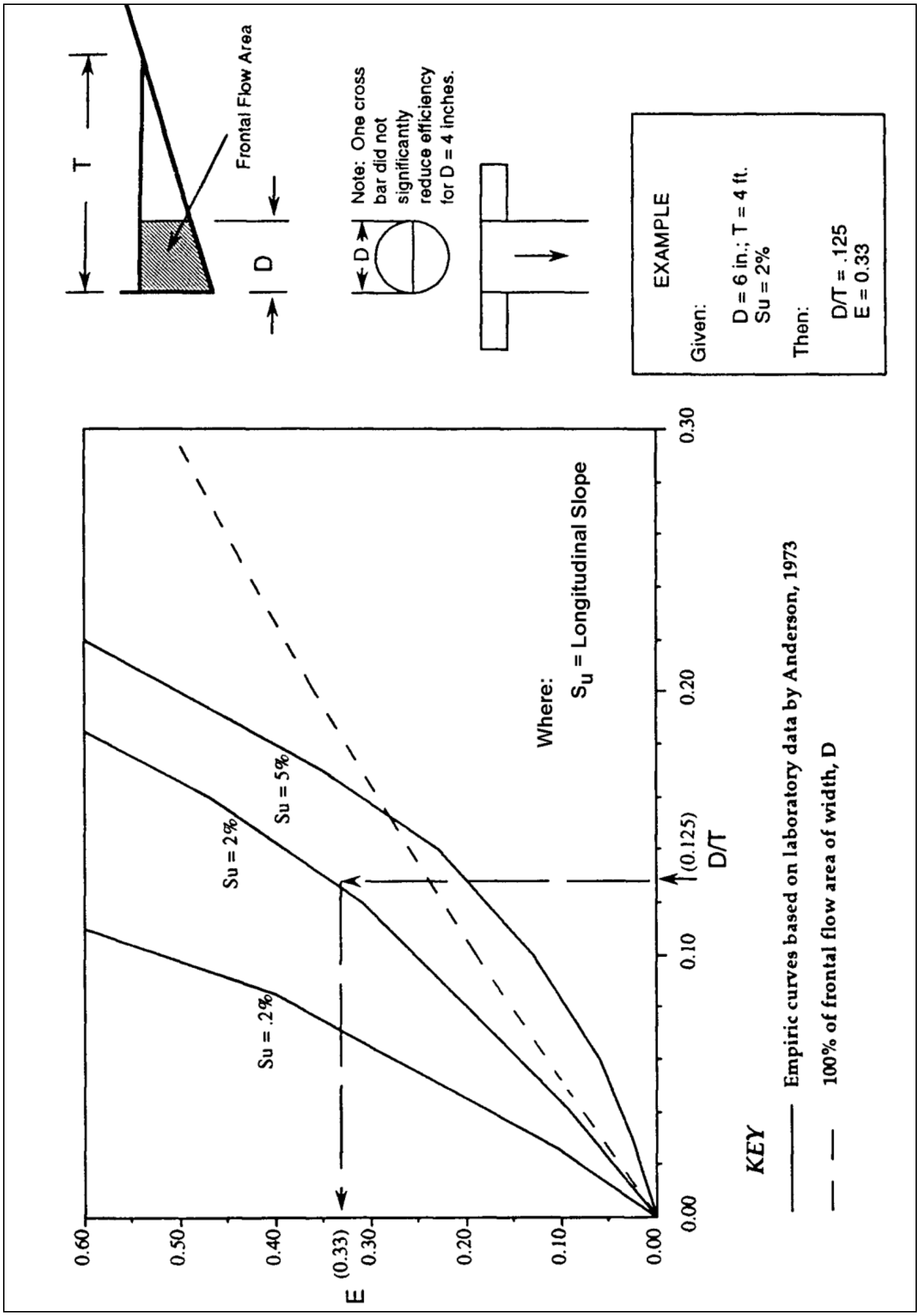

Figure 15.5. Efficiency Curves for Circular Scuppers.

(page intentionally left blank)